6 Capital Plan

This Capital Plan for the Downtown Circulator discusses the three primary capital expenditures that will be required. These are expenditures for the vehicle fleet, stops and stop amenities, and a storage and maintenance facility for the circulator vehicle fleet. It should be noted that the cost of providing a maintenance facility for Circulator Vehicles will be the responsibility of the selected service operator. Therefore, while presented here, the cost of such a facility will not be borne as a capital expense of the Circulator project. Similarly, bus shelters will be provided by the current bus shelter contractor in the District and will not be a direct expense of the project. As a result, vehicle costs will be the only capital expense of the Circulator project.

6.1 Vehicles

6.1.1 Vehicle Configuration Requirements

The configuration of a transit vehicle can vary depending on the type of market it is serving. The variations in configuration will include vehicle length, seat configuration, number and width of doors, and the level of the floor and the resultant type of boarding operations. The vehicle to be utilized on the circulator routes will be serving a market that is characterized by relatively short trips and potentially large volumes of boardings and alightings at individual stops (this will especially be true on the Monuments Route, which will predominantly serve visitors making short trips between the large number of tourist attractions along the route). Key elements of the vehicle configuration that will effectively serve this type of market include:

- **Low Floor** – One of the most important elements of the vehicle configuration impacting the speed of boardings and alightings is the vehicle floor level. The DCPG determined early in the planning process that the vehicles used on the circulator would be low floor. Because the level of the floor on a low floor vehicle is at curb height, there are no steps to climb to get into or out of the vehicle. This speeds the ingress and egress of both able bodied passengers as well as passengers who are physically handicapped. All vehicles identified in this analysis are low floor.
- **Door Width** – The width of both the front and back doors on the vehicle will be an important determinant of the speed with which boardings and alightings can occur. Standard door widths on vehicles identified as candidates for the circulator service range from approximately 29" to 46". Three candidate vehicles identified[37] have three doors. Among the vehicles identified as potential candidates for the circulator service, those with the widest doors are manufactured by Neoplan (between 36" and 45") and Thomas Built (both the front and rear doors are 42" wide).
- **Vehicle Length –** The operations plan assumed vehicles that can handle loadings of 50 to 55 passengers. Based on this loading requirement the length of the vehicles will have to

[37] The Neoplan AN440 TLF and the Volvo B10LE and B10L

be at least 35' long. Vehicles of between 35' and 45' were identified as potential candidates for the circulator service.[38]

- **Seat Configuration -** The number and configuration of the seats on the bus will impact the vehicle capacity as well as the speed of loading and off-loading passengers. The final seat configuration is variable and therefore can be adjusted to the specific market served by the bus. Given the ridership estimates, especially on the Monuments Route, a seat configuration that maximizes capacity will likely be required.
- **Identity –** Because many of the passengers utilizing the circulator system will be visitors who do not have a great deal of familiarity with the District of Columbia, a special system identity that is quickly recognizable is essential. This identity will be incorporated into the system signage as well as the shelters, but the place where it will be most important is in the look of the vehicles. Two options exist for developing an identity. In the first instance, the identity can come from fitting a standard coach with a unique paint scheme. The second option is to utilize a special design vehicle that has a unique and recognizable body type. Figure 6-1 shows examples of both appoaches. These special design buses are described in greater detail later in the report. The advantage of the unique body type of a special design bus is that it can be extremely recognizable and unique relative to other buses on downtown streets. The disadvantage is that each of the special design buses is in limited use and therefore there are additional issues associated with them such as parts availability and inventory, retrofitting maintenance facilities, and potentially unproven technologies. The advantage of using any of the standard coaches identified here is that it is a proven technology in wide use in North America and Europe, while the risk is that the paint scheme may not be unique enough on crowded downtown streets.

Figure 6-1: Unique Paint Scheme, Baltimore, MD - Unique Body Type, Irisbus Civis

[38] It should be noted that some of the special design vehicles identified herein do not meet this criterion. All special design vehicles were included in this analysis despite some not meeting this criterion because of the strong interest by the Partner Group in unique special vehicles.

In addition to these parameters, direction from the DCPG identified a number of additional vehicle characteristics that were considered essential. These include large windows to allow for maximum passenger viewing of passing sites and the fact that the vehicle should use clean fuel such as natural gas, electric-hyrbid propulsion (a hybrid system comprised of both an internal combustion engine and an electric motor), or purely electric propulsion. Therefore, vehicles were identified that met the following criteria:

- Low floor
- Large windows
- Clean fuels
- Adequate capacity (55 passengers)

Each of these elements was considered as part of the process for identifying candidate vehicles for the circulator service. A summary of each vehicle type is outlined below, grouped by type (standard natural gas, double deck, and special design bus). A summary Table showing relevant data on each vehicle is included as Appendix F. Color photos of vehicle candidates are contained in Appendix G.

6.1.2 Standard Natural Gas Vehicles

The largest number of vehicles available that match the requirements set by the DCPG are standard-vehicles that have the option of utilizing natural gas engines rather than diesel engines.

Manufacturers of standard vehicles with natural gas options include:

- El Dorado National
- New Flyer
- Neoplan
- North American Bus Industries
- Orion Bus
- Volvo
- Nova Bus
- MAN

Standard vehicles with a natural gas option are outlined in Appendix F. These types of vehicles have both advantages and disadvantages. The primary advantage of these standard vehicles is that they are in wide use throughout the country, and therefore have been tested in operation. Further, because maintenance practices do not differ greatly from those used on diesel buses, there could be a wider range of potential operators available to bid on the contract, thus increasing competition and potentially lowering costs. This wider range of potential contractors can also provide the DCPG more flexibility in selecting the circulator operator. The primary disadvantage of a natural gas vehicle fleet is that the fleet will require a maintenance facility with natural gas fueling capabilities. WMATA has one natural gas facility that is at capacity and though there are other potential contractors that run natural gas vehicles, a new or retrofitted facility to handle the addition of the large fleet of natural gas vehicles will likely be required.

The body types of the vehicles vary, with some having fairly unique looks while others are quite standard. Most of the body types have large windows, as required by the DCPG. A unique identity can be further enhanced through a unique paint scheme. Figure 6-1 contained a picture

of the Hampden Shuttle Bug in Baltimore, which utilizes a standard Thomas 30' vehicle but has a unique paint scheme that provides identity. This is one approach the DCPG may wish to take.

6.1.3 Double Deck Buses

Some interest was expressed in the use of double deck buses on the circulator system for both system identity and capacity purposes. Two low floor double deck manufacturers were identified; TransBus and Volvo. Both buses utilize diesel engines that are currently equipped with clean diesel technology. Research was conducted into alternative fuel options for double deck buses. In discussions with Transbus staff, they indicated that the use of natural gas fuels on double deck buses appeared infeasible because the typical location for natural gas fuel storage is on the roof of the vehicle, which would exacerbate existing issues related to double deck bus heights. However, Transbus is currently completing formal engineering investigation to assess the feasibility of utilizing a hybrid electric drive system being developed by the Allison Transmission Division of General Motors. If feasible, a vehicle utilizing this hybrid-electric drive would produce lower emissions than a vehicle fueled by natural gas.

The potential disadvantage in utilizing double deck buses is that maintenance facilities would have to be retrofitted to handle them, thus potentially increasing costs as well as potentially limiting the number of contract operators who would be willing to operate the service (retrofits would be required because of the bus height, and would also be required if the vehicle is equipped with an electric/hybrid drive). One additional potential disadvantage is interference from overhanging trees. Many sidewalk trees in the city overhang the street and these trees can brush against even regular buses running in the curb lane. This issue will be exacerbated for double deck buses, especially where trees overhang the street at bus stops (overhanging trees would be present on each of the planned routes). Despite the issues associated with overhanging trees, these double-deck buses are about 1 foot shorter than a typical tractor trailer, and there does not appear that there are any truck restrictions on any of the proposed circulator routes.

Examples of the double deck buses manufactured by TransBus and Volvo are outlined in Appendix F.

6.1.4 Special Design Buses

Special design buses that have both unique body types as well as alternative fuel applications were also considered. Manufacturers represented include Designline, TransTeq, North American Bus Industries, Advanced Vehicle Systems, and Civis, each of which produces hybrid-electric or fully electric vehicles. The advantage of these vehicles is that they have very unique body types and thus provide a distinct identity. The primary disadvantage in using these vehicles is that they are in limited operation and therefore the technologies may not be fully proven. Second, required maintenance practices that are different than standard diesel bus maintenance may limit the number of contractors that would be willing to run the service, thus potentially increasing operating costs. In addition, a new or retrofitted maintenance facility would be required to handle this new technology. A short description of each vehicle is outlined below.

The **Designline** vehicle is a low emission electric hybrid that is manufactured and utilized in New Zealand. The vehicle has a capacity of 37 passengers (21 seated, 16 standing). The vehicles are currently used for a downtown circulator system in Christchurch New Zealand. This vehicle is included in this analysis despite not meeting the capacity requirements of 55 passengers outlined above because of the DCPG's strong interest in unique and alternative vehicles.

The **North American Bus Industries 30C-LF CNG Hybrid-Electric Composite Concept Bus** has a capacity of 26 seated passengers and approximately 18 standees. Its length is 30'. The vehicle is not currently in use in operations. As with the Designline vehicle, this vehicle is included in this document despite not meeting the capacity requirements outlined above because of the DCPG's strong interest in alternative vehicles.

The **TransTeq EcoMark CNG/Electric Hybrid** is utilized to provide service on Denver's 16th Street Mall. This vehicle carries 116 passengers so it will not be appropriate for circulator service unless the vehicle can be modified as a smaller bus. The vehicle is now also being put into service at Los Angeles International Airport. Research indicates that these are the only two operational applications.

The **Advanced Vehicle Systems AVS38** is an 38' electric hybrid vehicle that can accommodate 39 seated passengers and 22 standing passengers in its maximum capacity configuration. The buses are being used in operations in New York City, Chattanooga Tennessee, and Tampa Florida.

The **Irisbus Tramway Civis** is a 61' heavy haul fully electric or electric/hybrid vehicle in service in Europe but nowhere in the United States as of yet. This vehicle has been designed for Bus Rapid Transit service, which is meant to replicate rail service utilizing a rubber tired vehicle, and therefore has significant passenger carrying capacity (over 100 when filled to capacity). This vehicle may be too large for a circulator application on busy downtown streets.

The **Irisbus Trolleybus Cristalis** is a 39' fully electric/hybrid electric vehicle manufactured by the same firm as the Irisbus Tramway Civis. This vehicle has the same look as the Irisbus Tramway Civis but has a smaller passenger carrying capacity. Based on its shorter length, this vehicle may be more suited to a circulator service on busy city streets.

The potential feasibility of utilizing some of the special design vehicles noted above is impacted by the Federal Transit Administration's (FTA) Buy America requirements for rolling stock purchases funded by the FTA. This Buy America stipulation requires that manufactured products such as rolling stock must be manufactured in the United States and have a 60% domestic content. In response to this requirement, many European bus manufacturers have set up factories in the United States to build vehicles for U.S. properties. However, it should be noted that these factories produce standard vehicles utilized throughout the U.S. while the special design vehicles identified above would not be produced in large quantities and therefore setting up a U.S. manufacturing operation for these vehicles may not be feasible or cost-effective.

The alternative to a U.S. manufacturing operation is to receive a waiver to the Buy America requirements. The two primary factors that will allow for a waiver is that if there is no equivalent U.S. product, which might apply to some of the special design vehicles identified above, or if there is a 25% cost differential between the U.S. product and the foreign product. If the DCPG choses to apply for a waiver, they would be required to present their argument for the waiver to the Federal Transit Administration and the FTA would deliberate on whether a waiver is appropriate given the circumstances. This application process and FTA review would likely take between 6 months to a year.

6.1.5 Vehicle Summaries/Advantages and Disadvantages

Table 6-1 shows a summary of the vehicles grouped by fuel type and vehicle size. Table 6-2, summarizes the data outlined in the previous paragraphs regarding the advantages and

disadvantages of the different vehicle types. Table 6-3 shows a ranking of vehicles by nine criteria noted in the previous sections. For each criterion, each vehicle is given a rating of one through four, with four being the most desirable.[39]

Based on the above assessment and considering the specific fuel and capacity requirements outlined by the DCPG, it is suggested that the Circulator move forward with a vehicle that is: 1) at least 35' long, 2) uses clean fuels, and 3) has a proven track record of use in North America. Using these criteria, two of the special design vehicles, the Designline City Bus, and North American Bus Industries Concept Bus, fall out of contention because they do not meet the circulator capacity requirements. A Natural Gas vehicle, the El Dorado National E-Z Rider II barely meets the passenger capacity requirements but is less than 35' and thus provides little flexibility on heavy travel days or routes.

Neither of the double deck buses identified in the process currently have a Natural Gas fuel option. TransBus is considering an electric hybrid drive system but this is an unproven technology.

Many of the other Electric/Electric hybrid vehicles identified meet these basic criteria but are in limited use in North America. These vehicles include the TransTeq EcoMark, which is in use only in Denver, the Advanced Vehicle Systems vehicle, which is in limited use in Nashville Tennessee, Tampa Florida, and New York City, the Irisbus Trolleybus Cristalis, and the Irisbus Tramway Civis neither of which are in use in North America. The latter two vehicles, along with the Designline City Bus, have the further disadvantage of not being manufactured in North America, which would require a Buy America waiver from the Federal Transit Administration. Procuring this waiver will add time to the process and there is no guarantee that the waiver can in fact be procured.

The remaining vehicles are standard buses already in wide use that have natural gas fuel options and meet the minimum length requirements. The use of one of these standard vehicles with an eye catching and unique paint scheme and graphics will address Buy America requirements, will meet the requirements for capacity and clean fuel technology, and will provide buses with a proven track record with North American Transit Systems.

If the DCPG wishes to use vehicles with a unique body type, there are several vehicles that meet the capacity and clean fuel requirements. Most of these do not meet the Buy America requirement. None have a long proven track record in North America, although some are in limited use. All are unique enough to require retrofitting of facilities and non-standard maintenance procedures which may limit the flexibility in finding a contractor who can provide the service.

[39] Note that a total rating is given. This is an unweighted total shown for convenience. This does not reflect a recommendation as to the most appropriate vehicle.

Table 6-1: Summary of Vehicles by Size and Fuel Type

Vehicle Size	Natural Gas	Electric/Electric Hybrid	Clean Diesel*
<35'	1. El Dorado National E-Z Rider II (30')	1. Designline City Bus (30') 2. North American Bus Industries Composite Concept Bus (30')	
35'–45'	1. New Flyer Model D40LF (40') 2. New Flyer Model D35LF (35') 3. Neoplan AN 440 TLF (40'or 45') 4. Neoplan AN 435 TLF (35') 5. North American Bus Industries 40LFW (40') 6. Orion Bus Orion VII Low Floor (40') 7. Volvo B10BLE (45') 8. Volvo B10L(40') 9. Nova Bus LFS (40') 10. MAN NM Low Floor MidiBus (35')	1. Advanced Vehicle Systems (38') 2. Irisbus Trolleybus Cristalis (39')	
>45'		1. TransTeq EcoMark (60') 2. Irisbus Tramway Civis (61')	
Double Deck			1. TransBus Trident (39') 2. Volvo Super Olympian (40')

* The double deck buses are currently only available with the clean diesel fuel option. However, TransBus is currently working with the Allison Drives Division of General Motors to examine the feasibility of equipping TransBus double deck buses with an electric/hybrid drive system.

Table 6-2: Summary of Advantages and Disadvantages

Vehicle Type	Advantages	Disadvantages
Standard Vehicles with Natural Gas Engines	• Wide use, proven design • Standard maintenance practices, no changes required to existing maintenance practices of potential operator • Can potentially utilize existing or future maintenance facilities equipped for Natural Gas vehicles • Sufficient passenger capacity to meet estimated demand. • Greater number of potential operating contractors based on wider familiarity with standard vehicles – greater flexibility in selecting contractor	• May have insufficient uniqueness in body type for identity purposes. • New or retrofitted facility to handle natural gas will likely be required.
Double Deck Buses	• Unique identity • Passenger carrying capacity	• Fewer model choices available • Operations and Maintenance facility retrofits will likely be required • O&M facility limitations may limit number of contractors willing to bid to run the system • Unlikely to be available in natural gas fuel option – electric hybrid propulsion system untested. Contractor unfamiliarity with electric/hybrid system may limit number of contractors willing to bid. • Potential interference from street trees and other clearance problems.
Special Design Buses	• Unique identity	• Some vehicles are in limited use and therefore are an unproven technology • Off shore manufacturing requires FTA Buy America waiver • O&M facilities will require special retrofits to handle new technology. • Some potential contractors may not be willing to compete on contract because they do not have the capability to maintain vehicles, therefore constraining the DCPG's flexibility in selecting a contractor. • Some vehicles do not have required capacity to meet estimated demand.

Table 6-3: Ranking of Vehicles

Type	Model	Facility Retrofits Required	Buy America	Proven Track Record	Meets Capacity Requirements	Unique Body	Standard Maintenance Practices	Flexibilty in Contractor	Vehicle Retrofit	Availability of Clean Fuel Technology	Total Score
Standard Bus - Natural Gas	El Dorado E-Z Rider II	3	4	4	2	1	4	4	4	4	30
	New Flyer Model D40LF	3	4	4	4	1	4	4	4	4	32
	New Flyer Model D35LF	3	4	4	4	1	4	4	4	4	32
	Neoplan AN 440 TLF	3	4	4	4	1	4	4	4	4	32
	Neoplan AN 435 TLF	3	4	4	4	1	4	4	4	4	32
	NABI 40LFW	3	4	4	4	1	4	4	4	4	32
	Orion Bus Orion VII Low Floor	3	4	4	4	1	4	4	4	4	32
	Volvo B10BLE	3	4	4	4	1	4	4	4	4	32
	Volvo B10BL	3	4	4	4	1	4	4	4	4	32
	Nova Bus LFS	3	4	4	4	1	4	4	4	4	32
	MAN NM Low Floor MidiBus	3	4	4	4	1	4	4	4	4	32
Special Design - Electric/Hybrid Electric	Designline City Bus	1	1	1	1	4	1	1	4	4	18
	NABI Composite Concept Bus	1	4	1	1	4	1	1	4	4	21
	Advanced Vehicle Systems	1	4	2	4	2	1	1	4	4	23
	Irisbus Trolleybus Cristalis	1	1	1	4	4	1	1	4	4	21
	TransTeq Ecomark	1	4	2	4	3	1	1	4	4	24
	Irisbus Tramway Civis	1	1	1	4	4	1	1	4	4	21
Double Deck	TransBus Trident	1	2	3	4	3	3	2	1	1	20
	Volvo Super Olympian	1	2	3	4	3	3	2	1	1	20

6.1.6 Estimated Vehicle Costs

Based on the range of candidate vehicles, the associated range of vehicle capital costs are summarized in Table 6-4 below.

Table 6-4: Vehicle Capital Costs

Vehicle Type	Required # of Vehicles*	Cost Per Vehicle**	Total Vehicle Cost
35' Standard Natural Gas	90	$260,000	$23,400,000
40' Standard Natural Gas	90	$280,000	$25,200,000
Double Deck	90	$270,000	$24,300,000
Electric/Electric Hybrid	90	$285,000	$25,650,000

* The assumption for the required number of vehicles is based on the project operating plan. Different vehicles will have different capacities and therefore some modifications of the operating plan to reduce the number of vehicles may be possible. These potential savings are not incorporated into the capital cost calculations included in this table or in the operating cost elsewhere in this plan.

** Costs per vehicle were estimated utilizing the Federal Transit Administration's "Statistics on Appropriations for Vehicle Purchases for FY 2001.

6.2 Stops and Stop Amenities

Bus stops and stop amenities will be installed and maintained via a contract with a bus shelter advertiser. Under this arrangement, the advertiser recoups the cost of installation and the maintenance program through the sale of advertising on the shelters. This arrangement is quite common and in place in a number of jurisdictions. The contract with the advertiser in Washington D.C. will be written such that the advertiser will be responsible for installing unique shelters and stop amenities at circulator-only stops as part of its larger city-wide contract. Further, the contract will stipulate that certain Circulator stops will have no advertising (the costs of installing the circulator shelters will be recouped by increasing advertising on other shelters in the city). Because the responsibility for stop amenity installation will rest with the advertising firm, the project will bear no capital cost for this project element.

6.3 Storage and Maintenance Facility

The large vehicle fleet (90 vehicles) necessary for the circulator service may very well require an entirely new maintenance and storage facility. Capital costs and acreage requirements were estimated for the new fleet based on work completed as part of the Washington Metropolitan Regional Bus Study. Based on this work the estimated facility acreage requirement will be ***5.9 acres***. [40] The estimated capital cost of the storage and maintenance facility is ***$56,398,593*** (see Table 6-5 below for greater detail), including the cost of land purchase. This estimate is based on the estimated cost of a 100-vehicle urban facility from the Regional Bus Study. Land costs are

[40] The garage plan portion of the Regional Bus Study calculated acreage requirements for both urban and suburban facility types, for a range of the number of buses to be handled at the facility (acreage requirements were developed for a 50, 100, 150, 200, and 250 bus facility). The acreage estimate identified for the circulator facility is based on the acreage required for an urban facility supporting 100 vehicles.

based on the average cost of land in the District of Columbia based on data received from WMATA and the real estate industry.

Table 6-5: Garage Capital Costs

Program Element	Unit	Cost	20% Contingency	Total
Site Work	SF	$2,058,358	$411,672	$2,470,029
Operations and Maintenance Building	SF	$14,215,563	$2,843,113	$17,058,675
Bus Parking	SF	$5,410,000	$1,082,000	$6,492,000
Employee Parking	SF	$1,080,000	$216,000	$1,296,000
Furniture/Equipment	SF	$1,421,556	$284,311	$1,705,868
Soft Costs*	LS	$12,092,738	$2,418,548	$14,511,286
Land	LS			$12,864,735
Total				**$56,398,593**

*Soft Costs include design fees and expenses, construction management fees, testing/monitoring, permits, and communication systems.